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EFFECT OF HOT WATER TREATMENT ON POSTHARVEST QUALITY OF CUCUMBER FRUITS.

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ABSTRACT

This study was carried out on the cultivar Primo of cucumber to evaluate a range of hot water temperature as a dipping method at different time to control decay and on storability of fruits during 1998-1999 and 1999-2000 seasons.

Cucumber fruits weight loss and decay percentages and pitting increased, whereas firmness and chlorophyll content were decreased with the prolongation of storage period. T.S.S. content increased till its peaks at 6 days then decreased till the end of storage period.

The results indicated that cucumber fruits immersion in hot water at 43°C for 6 min. and 48°C for 3 or 6 min. controlled decay without causing external heat injury. However, dipping at 53 or 58°C hot water for 1 or 2 min. increase cucumber susceptibility to postharvest decay and resulted in heat injury characterized by well defined pitted and poor appearance. Dipping cucumber fruits in hot water treatment led to increase the percentage of weight loss, maintained fruit firmness and delayed the losses in chlorophyll during storage when compared with unheated control. Using hot water at 48°C for 3 or 6 min. followed by 43°C for 6 min. was the most obvious one in this regard

These results showed that hot water treatment was effective in controlling postharvest decay organisms and in maintaining physical and chemical quality and should be considered as a non-chemical control for decay during storage of cucumber fruits.

INTRODUCTION

There is an increasing interest and need to evaluate potential alternative treatments to postharvest fungicide use. This interest exists for both the organic and conventional markets, and for both the domestic and international market.

The use of hot water treatment is an especially attractive alternative for decay control since such treatments can control pathogens on and below the surface of the product, providing greater decay control than contact sanitizers and fungicides.

Other potential benefits of the use of hot water treatments include; 1) modifying ripening and storage behavior by reducing the activity of certain enzymes associated with deterioration; 2) may also be applicable as a quarantine treatment; 3) provides a clean, economical, relatively easy to apply treatment which is compatible with current postharvest handling, regardless of the scale of operation.

The efficacy of hot water to control pastharvest pathogens and prolonging the storability has been demonstrated by several researchers. Thus, Lester (1989) on muskmelon; Harvey *et al.* (1989) on cucumber; William *et al.* (1981) on muskmelon, McDonald *et al.* (1999) on tomato and Barkai and phillips (1991) found that immersion fruits in hot water treatment

was effective in controlling decay activity and maintaining physical quality of fruits during storage.

Harvey *et al.* (1989) on cucumber and Teitel *et al.* (1991) on melon pointed that higher temperature and/or longer exposure time of hot water treatment resulted in heat injury characterized by well defined pitting and necrobic spots. While Cantwell and Nie (1992) on tomato and melon reported that longer hot water treatment at lower temperature to be more efficient in controlling the development of rot without causing external heat injury on melon fruits during storage,

Furthermore, dipping fruits in hot water led to increase the percentage of weight loss (Klein and Lurie, 1990 on apple; Hallman, 1991 and McGuire, 1991 on grapefruit). Dipping fruit in hot water maintained fruit firmness and had no effect of total soluble solids during storage (Liu, 1978, Porritt and Lidster, 1978 on apple and William *et al.* 1981 on muskmelon). In addition, Mayberry and Hartz (1992) reported that general appearance of muskmelon fruit treated with hot water was significantly better than untreated fruits. Harvey *et al.* (1989) on cucumber and Kazami *et al.* (1991a) on broccoli found that dipping fruits in hot water delayed the chlorophyll losses during storage.

The objectives of this work was to evaluate a range of hot water temperature (non-chemical agents) at different time for controlling decay, increasing storability and maintaining the quality of cucumber fruits during extended storage.

MATERIALS AND METHODS

Cucumber plants (C*ucumis sativus* L.) Cv. Primo were grown under plastic house conditions of Kaha Experimental Farm, Agricultural Research Center during two successive seasons of 1998-1999 and 1999-2000.

Seeds were sown in plastic house of 60 x *8.5* x *3.5* m, dimensions on 25th and 28th of October in 1998 and 1999, respectively. Normal cultural practices were carried out whenever it was needed according to the recommendation of Ministry of Agriculture. Fruits of cucumber were harvested at the proper stage of marketing (60 days after sowing) then transferred to the laboratory at Giza. The fruits were sorted and those of uniform size and which were defect-free were randomized into nine groups of three replications (5 Kg for each), the first one was taken as control (unheated treatment) and the remaining eight groups were dipped in range of hot water temperature at different time, then the treatments of this work were as follows:

1- 43^{0}C for 3 minutes 2- 43^{0}C for 6 minutes
3- 48^{0}C for 3 minutes 4- 48^{0}C for 6 minutes
5- 53^{0}C for 1 minute 6- *53^{0}C* for 2 minutes
7- 58^{0}C for 1 minute 8- 58^{0}C for 2 minutes
9- Control (dipped in tap water *25^{0}C).*

Fruits were air dried at 25^{0}C after hot-water treatments,(each replicate of every treatment was divided into 5 replicates) and fruits of each of them (About 800 g) were placed in carton box (30 x 20 x 10 cm). The

treatments were arranged in a complete randomized block design with 3 replicates. Fruits for all treatments stored in cold room at (10^0C and *90%* R.H). Fruits of three replicates of each treatment were evaluated periodically (every 3 days interval) for the following quality measurements.

1- Decay, weight loss and total soluble solids (T.S.S.) in percent.
2- Firmness (N) using Magness and Ballauf pressure tester equipped with 3/16 inch plunger and adjusted in Newton (as recommended by ASHS postharvest working group.
3- Appearance using score as follows 9 = excellent, 7 = good, *5* = fair and 3 = poor.
4- Pitting using score as follow (1= none, 2= slight, 3 = moderate, 4= severe and *5*= external severe.
5- Total chlorophyll (mg/100 g fresh weight) were carried out as (A.O.A.C. 1980).

Data were statistically analyzed according to Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

Data in Table (1) demonstrate that decay percentage started slowly and successively increased till the end of storage. This finding may be due to the continuous chemical and biochemical changes happened in the fruits such as moisture condensation and transformation of complex compounds to simple forms of a more liability to fungal infection such as the solid protopectin to the soluble pectin form. These results are in harmony with those obtained by El-Sheikh and El-Doweny (1997) on cucumber.

For the same data, it was reasonable to say that lower temperature and longer immersion time in hot water would be more efficient in controlling the development decay during storage. Cucumber fruit dipping in hot water at 48^0C or 43^0C for 6 mm. markedly reduce of decay in fruits during the storage period. These treatments resulted in 4.59 and 6.25*%* decay (average of the two seasons), respectively compared with 12.49% (average of the two seasons) in untreated fruit. Dipping the fruits in hot water resulted in some decrease in fungal development may be related to washing off of some of the natural pathogenic spore population from the surface of the fruit. However, such a dip may also remove part of the natural antagonistic flora inhibiting the fruit peel which may act as a biocontrol agent of postharvest pathogens (Harvdy *et al.*,1989 on cucumber).

In general, a shorter duration of dipping at 43^0C (3 min.) was markedly less effective in reducing decay. These findings found supported by the work of Lester (1989) on muskmelon.

However, dipping cucumber fruits in hot water at 53 and 58^0C for 1 or 2 min. increase cucumber susceptibility to postharvest decay (Table 1). This increase in postharvest decay susceptibility may be the result of heat damage to the epidermal cells, which would allow the easy access and establishment of pathogens (Harvey et at 1989) on cucumber.

Table (1): Effect of hot water treatment on decay percentage of cucumber fruits during storage in 1998-1999 and 1999-2000 seasons.

Storage Period	3 min.		6 min.		1 min.		2 min.		Control	Mean
	43°C	48°C	43°C	48°C	53°C	58°C	53°C	58°C		
1998 – 1999 season										
3	00.00	00.00	00.00	00.00	00.00	00.00	00.00	5.82	00.00	0.65
6	00.00	00.00	00.00	00.00	13.37	19.18	17.29	20.85	3.94	8.29
9	20.78	15.44	5.82	3.94	23.54	30.05	27.05	33.17	19.22	19.55
12	26.22	18.87	18.19	14.12	39.83	50.83	45.87	54.17	30.81	33.27
Mean	11.75	8.58	6.00	4.52	19.19	25.02	22.55	28.5	13.49	
1999 – 2000 season										
3	00.00	00.00	00.00	00.00	00.00	00.00	00.00	4.05	00.00	0.45
6	00.00	00.00	00.00	00.00	6.50	11.30	6.86	12.56	00.00	4.14
9	13.86	8.08	4.75	00.00	15.76	27.22	17.19	31.20	15.01	14.79
12	25.16	23.77	21.27	18.55	31.80	44.82	36.72	48.87	30.93	31.32
Mean	9.76	7.96	6.51	4.64	13.52	20.84	15.19	24.17	11.49	

From the previous results it can be concluded that, the maximal benefit of prestorage hot water was found to be achieved at 48^0C 3 or 6 min. followed by 43^0C for 6 min., cucumber held at 53 and 58^0C for 1 or 2 min. were higher decay, while those treated to 43^0C for 3 min. were unaffected.

With respect to weight loss during storage period data in Table (2) indicated that weight loss percentage of cucumber fruits increased considerably and consistently with the prolongation of the storage period. This decrease in weight might be attributed to the loss in moisture through transpiration and loss in dry matter content through respiration. Similar conclusions have been reported by El Sheikh and El-Doweny (1997) on cucumber.

In general dipping cucumber fruits in hot water treatment led to increase the percentage of weight loss. However, the higher the temperature and the longer the duration of the hot water, the higher the percentage of loss in weight. In another word, dipping fruits in water at 53 and 58^0C for 2 min. gave the highest value of weight loss during storage, while the lowest values of weight loss was obtained in untreated control followed by fruits of hot water treatments at 43^0C for 3 or 6 min. and 48^0C for3 min. which appeared to be the best treatments in the losses reduction. These results were in line with those reported by Sarah *et al.* (1987) on muskmelon; McGuire (1991) on grapefruit found that dipping fruits in hot water accelerate weight loss during storage.

The interaction between hot water treatments and storage period was significant on weight loss percentage.

Table (2): Effect of hot water treatment on weight loss percentage of cucumber fruits during storage in 1998-1999 and 1999-2000 seasons.

Storage Period	3 min.		6 min.		1 min.		2 min.		Control	Mean
	43°C	48°C	43°C	48°C	53°C	58°C	53°C	58°C		
1998 – 1999 season										
0	2.80	3.02	2.92	3.14	3.15	3.19	3.37	3.52	2.64	3.08
3	5.20	5.41	5.26	6.12	5.97	6.75	6.94	7.14	5.02	5.98
6	7.80	8.04	8.00	9.50	8.65	8.78	8.92	9.18	7.52	8.49
9	10.00	10.74	10.52	10.85	11.32	11.52	11.77	11.89	10.10	10.97
Mean	6.45	6.80	6.68	7.40	7.27	7.56	7.75	7.93	6.32	
L.S.D at 5%	Storage period: 0.06									
	Heat treatment: 0.08									
	S. period x H. treatment: 0.14									
1999 – 2000 season										
0	3.06	3.22	3.14	3.35	3.39	3.42	3.64	3.83	2.94	3.33
3	5.28	5.43	5.32	5.22	5.61	5.73	5.84	5.97	5.02	5.49
6	7.91	8.06	7.95	8.17	8.24	8.30	8.38	8.56	7.87	8.16
9	11.06	11.15	11.10	11.30	11.64	11.78	11.97	12.18	11.00	11.46
Mean	6.83	6.97	6.88	7.01	7.22	7.31	7.46	7.64	6.71	
L.S.D at 5%	Storage period: 0.04									
	Heat treatment: 0.07									
	S. period x H. treatment: 0.13									

Data in Table (3) indicate that general appearance of the cucumber fruit immersed at 43^0C for 6 min. or 48^0C for 3 or 6 min. was better than that fruit immersed in 53 or 48^0C for 1 or 2 min.. In another word, fruit treated with 43^0C for 6 min. or 48^0C for 3 or 6 min. did not exhibit any changes in their appearance till the 9th day of storage and gave fruits with good appearance at the end of storage periods, while using 43^0C for 3 min. or 53^0C for 1 min, reflected fair appearance, immersing cucumber fruits in hot water at 53^0C for 2 min. or 58^0C for 1 and 2 min. or control treatments resulted in poor fruit appearance at the end of storage periods. These results are in harmony with those obtained by Sarah *et al.* (1987) on muskmelon.

The effect of hot water treatment on the pitting of cucumber fruits in Table (4) show clearly that this disteration occurred only in cucumber fruits dipped in hot water at 53 and 58^0C either for 1 or 2 min. at 6 days and 3 days of storage in the first and second season, respectively and increased with the elapse of storage periods. However, longer duration of dipping at 53^0C and 58^0C was markedly higher effective in increasing pitting. This increase in pitting may be due to the result of heat injury characterized which expressed as surface pitting (Harvey *et al.*,1989) on cucumber, while McDonald *et al.*(1999)found that the putrescine accumulation was greater in the tissues of fruit dipping in high temperature of hot water than the low.

Table (3): Effect of hot water treatment on appearance (score) of cucumber fruits during storage in 1998-1999 and 1999-2000 seasons.

Storage Period	3 min.		6 min.		1 min.		2 min.		Control	Mean
	43○C	48○C	43○C	48○C	53○C	58○C	53○C	58○C		
1998 – 1999 season										
0	9	9	9	9	9	9	9	9	9	9.0
3	9	9	9	9	9	9	9	9	9	9.0
6	9	9	9	9	7	7	7	7	7	7.9
9	7	9	9	9	7	5	5	5	5	6.8
12	5	7	7	7	5	3	3	3	3	4.8
Mean	8.2	8.6	8.6	8.6	7.4	6.6	6.6	6.6	6.6	
1999 – 2000 season										
0	9	9	9	9	9	9	9	9	9	9.0
3	9	9	9	9	9	9	9	9	9	9.0
6	9	9	9	9	9	7	7	7	7	8.1
9	7	9	9	9	7	5	7	5	5	7.0
12	5	7	7	7	5	3	3	3	3	4.8
Mean	8.2	8.6	8.6	8.6	8.2	6.6	7.0	6.6	6.6	

The high concentration of this chemical in the preicarp tissue induced fruits with pitting appearance. On the other side of view, cucumber fruits dipped in hot water at 43 and 48^{0}C for 3 or 6 min. and control (unheated) did not show any pitting during storage. These results are in agreement with those reported by Harvey *et al.* (1989) on cucumber and Mayberry and Hartz (1992) on muskmelon, who found that higher temperature and longer duration of hot water dipping resulted in heat injury characterized by well defined pitted and poor appearance.

Table (4): Effect of hot water treatment on pitting (score) of cucumber fruits during storage in 1998-1999 and 1999-2000 seasons.

Storage Period	3 min.		6 min.		1 min.		2 min.		Control	Mean
	43○C	48○C	43○C	48○C	53○C	58○C	53○C	58○C		
1998 – 1999 season										
0	1	1	1	1	1	1	1	1	1	1.0
3	1	1	1	1	1	1	1	1	1	1.0
6	1	1	1	1	2	2	2	2	1	1.4
9	1	1	1	1	2	2	3	3	1	1.7
12	1	1	1	1	3	3	4	4	1	2.1
Mean	1.0	1.0	1.0	1.0	1.8	1.8	2.2	2.2	1.0	
1999 – 2000 season										
0	1	1	1	1	1	1	1	1	1	1.0
3	1	1	1	1	2	2	3	3	1	1.7
6	1	1	1	1	2	2	3	3	1	1.7
9	1	1	1	1	2	3	3	4	1	1.9
12	1	1	1	1	3	4	4	5	1	2.3
Mean	1.0	1.0	1.0	1.0	2.0	2.4	2.8	3.2	1	

Concerning, fruit firmness, data in Table (5) show that there was gradually and consistently decrease with the prolongation of storage period and reached the lowest value at the end of storage period in the two seasons

(El-Sheikh and Doweny, 1997) on cucumber. Softening in fruit was attributed to the change of protopectin to soluble pectin (Wills *et al.*, 1981).

Moreover, data presented in general that dipping cucumber fruits in hot water were firmer than those with control (unheated). However, the highest value of fruit firmness were obtained from fruit treated with 48^{0}C for 3 or 6 min. followed by 43^{0}C for 6 min., while 53^{0}C for 2 min. and 58^{0}C for 1 or 2 min. were less effective in maintaining fruit firmness.

The effect of the interaction between storage period and hot water treatment was significant on fruit firmness in both seasons.

Table (5): Effect of hot water treatment on firmness (N) of cucumber fruits during storage in 1998-1999 and 1999-2000 seasons.

Storage Period	3 min.		6 min.		1 min.		2 min.		Control	Mean
	43°C	48°C	43°C	48°C	53°C	58°C	53°C	58°C		
1998 – 1999 season										
0	48.23	48.23	48.23	48.23	48.23	48.23	48.23	48.23	48.23	48.23
3	40.62	45.36	42.30	43.77	41.30	40.66	40.40	39.53	38.67	41.4
6	36.12	41.03	39.53	40.40	39.53	36.07	36.33	35.80	34.20	37.67
9	33.24	40.40	38.66	39.53	39.03	32.60	34.87	32.77	31.10	35.8
12	28.15	34.87	33.40	34.13	33.40	27.63	31.10	28.66	26.70	30.89
Mean	37.27	41.98	40.42	41.21	40.30	37.04	38.19	37.00	35.78	
L.S.D at 5%	Storage period: 1.93									
	Heat treatment: 2.15									
	S. period x H. treatment: 3.03									
1999 – 2000 season										
0	44.50	44.50	44.50	44.50	44.50	44.50	44.50	44.50	44.50	44.5
3	40.64	43.03	41.03	42.30	40.33	38.66	40.17	38.66	37.80	40.29
6	36.87	41.03	39.53	40.40	38.63	36.33	36.93	36.40	34.93	37.89
9	34.64	40.40	37.80	38.67	37.20	35.60	34.53	34.27	32.77	36.21
12	31.06	38.67	35.60	37.07	34.93	34.27	33.93	32.77	31.10	34.38
Mean	37.54	41.53	39.69	40.59	39.12	37.87	38.01	37.32	36.22	
L.S.D at 5%	Storage period: 1.30									
	Heat treatment: 1.86									
	S. period x H. treatment: 2.22									

The marked reduction in softening is the main benefit obtained by the hot water treatment. This was observed as well by Liu (1978) and Porritt and Lidster (1978) on apple fruits. The reasons for the lack of softening may be due to inhibition of the cell wall degrading enzymes. During shelf life, the insoluble pectin fraction remained larger in the heat treated fruits compared with unheated one. (Klein and Lurie, 1990 on apple).

Data in Table (6) indicated that total soluble solids increased with prolongation storage period until 6 days, then it began to decrease gradually. The increment in T.S.S. at the first period of storage might owe to the higher rate of moisture loss through transpiration than the rate of dry matter loss through respiration. The reduction at the end of storage period might owe to the utilization of sugars in respiration. However, cucumber fruits dipping in hot water at 43 ^{o}C for 6 min. and 48 ^{o}C for 3 or 6 min. contained more T.S.S contents as compared with untreated or treated with 53 ^{o}C and 58 ^{o}C for 1 or 2 min., while heated to 43^{o}C for 3 min. were largely unaffected.

Table (6): Effect of hot water treatment on T.S.S. content of cucumber fruits during storage in 1998-1999 and 1999-2000 seasons.

Storage Period	3 min.		6 min.		1 min.		2 min.		Control	Mean
	43°C	48°C	43°C	48°C	53°C	58°C	53°C	58°C		
1998 – 1999 season										
0	4.53	4.53	4.53	4.53	4.53	4.53	4.53	4.53	4.53	4.53
3	4.63	4.73	4.73	4.83	4.63	4.53	4.63	4.58	4.63	4.66
6	4.73	4.90	4.86	4.86	4.70	4.60	4.66	4.63	4.70	4.74
9	4.43	4.73	4.66	4.73	4.37	4.20	4.33	4.30	4.40	4.46
12	4.17	4.47	4.40	4.50	4.03	4.00	4.00	3.84	4.10	4.17
Mean	4.50	4.67	4.64	4.69	4.45	4.37	4.43	4.38	4.47	
L.S.D at 5%	Storage period: 0.09									
	Heat treatment: 0.17									
	S. period x H. treatment: 0.34									
1999 – 2000 season										
0	4.33	4.33	4.33	4.33	4.33	4.33	4.33	4.33	4.33	4.33
3	4.50	4.53	4.53	4.58	4.35	4.40	4.43	4.50	4.50	4.48
6	4.60	4.73	4.70	4.73	4.42	4.47	4.50	4.50	4.57	4.58
9	4.30	4.47	4.43	4.51	4.16	4.07	4.13	4.13	4.20	4.27
12	3.97	4.20	4.17	4.22	3.82	3.70	3.77	3.07	3.90	3.87
Mean	4.34	4.45	4.43	4.47	4.22	4.19	4.23	4.11	4.30	
L.S.D at 5%	Storage period: 0.10									
	Heat treatment: 0.15									
	S. period x H. treatment: 0.33									

The effect of interaction between storage period and hot water treatments on T.S.S. of cucumber fruits was significant in both seasons.

Data in Table (7) show that chlorophyll content in cucumber fruits decreased gradually with the prolongation of storage period in the two seasons. This decrement in chlorophyll content could be attributed to the gradual destruction by chlorophyllase activity and transformation of chlorophlasts to chromoplasts. These results agree with those obtained by El-Sheikh, (1979) and El-Sheikh and El-Doweny (1997) on cucumber.

However, the same data indicate that hot water treatments inhibited chlorophyll loss in cucumber fruits during storage compared with unheated control. Treatment temperatures tested, 43 and 58°C were least effective; 48 to 53 °C reduced the rate of chlorophyll loss. 48 °C was the most effective treatment for reducing chlorophyll loss. These results were true in the two seasons and may be due to hot water treatments which inhibited chlorophyllase enzyme (Kazami *et al.*, 1991a on broccoli).

Generally, the loss of chlorophyll content was significant for shortest immersion time and decreased with increasing immersion time. This relationship suggests that the shorter immersion time activates the degreening system, while longer immersion times inactive it. The inactivation

associated with the longer immersion times may be the result of heat inactivation of chlorophyllase. (Harvey *et al.*, 1989 on cucumber).

Table (7): Effect of hot water treatment on chlorophyll content (mg/100g fresh weight) of cucumber fruits during storage in 1998-1999 and 1999-2000 seasons.

Storage Period	3 min.		6 min.		1 min.		2 min.		Control	Mean
	43°C	48°C	43°C	48°C	53°C	58°C	53°C	58°C		
1998 – 1999 season										
0	168.33	168.33	168.33	168.33	168.33	168.33	168.33	168.33	168.33	168.33
3	151.76	158.17	152.68	158.50	155.30	154.73	157.27	155.37	152.96	155.19
6	144.33	148.17	145.46	149.20	146.57	146.13	147.17	146.50	144.33	146.43
9	137.00	141.27	139.13	141.43	140.07	137.13	141.07	138.40	138.00	139.28
12	125.80	132.20	126.17	132.60	129.10	125.33	131.40	130.47	126.00	128.79
Mean	145.44	149.63	146.35	150.01	147.87	146.33	149.05	147.81	145.92	

L.S.D at 5% Storage period: 0.66
Heat treatment: 0.90
S. period x H. treatment: 1.63

1999 – 2000 season										
0	154.20	154.00	154.20	154.20	154.20	154.20	154.20	154.20	154.20	154.20
3	143.03	147.00	144.57	148.63	146.57	142.10	147.27	143.33	141.20	144.86
6	131.37	137.10	127.63	138.57	136.66	128.30	137.43	130.27	128.17	132.83
9	123.73	130.00	120.07	128.73	122.57	116.33	124.30	118.37	116.37	122.27
12	110.33	119.03	113.13	120.83	114.80	105.43	118.50	105.77	105.63	112.61
Mean	129.27	137.43	130.39	138.19	134.96	129.27	136.34	130.39	129.11	

L.S.D at 5% Storage period: 0.71
Heat treatment: 0.93
S. period x H. treatment: 1.68

The interaction between storage period and hot water treatment was significant on chlorophyll content in both seasons.

From the previous results, it could be suggested that cucumber fruits immersion in hot water at 43°C for 6 min. and / or 48°C for 3 or 6 min. were effective in controlling postharvest decay organisms and maintained fruit firmness, delayed the chlorophyll loss and gave good appearance without causing external heat injury and should be considered as a non-chemical control for decay during storage.

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تأثير المعاملة بالماء الساخن علي جودة ثمار الخيار بعد الحصاد

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أجريت هذه الدراسة علي الخيار صنف بريمو خلال موسمي ١٩٩٨-١٩٩٩ , ١٩٩٩-٢٠٠٠ و ذلك لدراسة تاثير غمر ثمار الخيار في الماء الساخن علي التحكم في التلف و زيادة القدرة التخزينية.

أوضحت النتائج أن هناك زيادة في فقد الوزن و التالف و النقر و نقص في الكلوروفيل و الصلابة مع إطالة فترة التخزين بينما زادت المواد الصلبة الذائبة حتي وصلت إلي أعلي معدل لها بعد ٦ أيام من التخزين ثم بدأت في النقص مع زيادة فترة التخزين حتي ١٢ يوم .

كما أوضحت النتائج أن غمر الثمار علي ٤٣ ْم لمدة ٦ دقائق أو ٤٨ ْم لمدة ٣ أو ٦ دقائق أدى إلي تقليل التالف بدون حدوث ألاضرار الناتجة عن الحرارة علي ثمار الخيار بينما نجد أن غمر الثمار علي درجة ٥٣ أو ٥٨ ْم لمدة ١ أو ٢ دقيقة أدي إلي زيادة قابلية الثمار للتلف بعد الحصاد و حدوث أضرار الحرارة (علي شكل نقر علي سطح الثمرة و المظهر الغير جيد). كما أدي غمر الثمار في الماء الساخن إلي زيادة فقد الوزن مع المحافظة علي صلابة الثمار و تأخير فقد الكلوروفيل خلال التخزين و ذلك مقارنة بالكنترول (غير المعاملة). لقد أعطى استخدام الغمر في الماء على درجة ٤٨ ْم لمدة ٣ او ٦ دقائق يليه ٤٣ ْم لمدة ٦ دقائق افضل النتائج بخصوص تلك الصفات.

و بذلك تكون المعاملة بالماء الساخن طريقة طبيعية ذات تاثير فعال فى تقليل تلف ثمار الخيار بعد الحصاد مع المحافظة علي صفات جودتها.